TITLE OF INVENTION

Portable, surface-mounted well pump

BACKGROUND OF THE INVENTION

Monitoring wells installed as part of groundwater investigations related to leaking surface or underground storage tanks are typically constructed of two or four inch diameter PVC casing and well screen to between 20 to 100+ feet depending on the depth to groundwater. The protocol for taking water samples from these monitoring wells requires that the well be pumped or bailed until three to five well volumes have been removed, the well dewaters, or successive measurements of indicator parameters pH, temperature, and electrical conductivity have stabilized.

For water level depths less than about 25 feet an electric surface suction pump and an inwell purge tube is often used to pump the well. The inwell purge tube has a check valve at is bottom so that rapid up and down motion of the purge tube will fill the tube with water and allow the surface suction pump to be primed. Once the surface suctions pump is primed, the pump will deliver water from the well until the water level declines to a theoretical limit of about 30 feet below the suction pump depending on ambient atmospheric pressure (14.7 psi = 33.9 feet). As the water level depth increases due to pumping, the flow rate declines because of the increased lift required. Flow rates up to 3 gallons per minute are attainable with surface suction pumps.

For water level depths greater than about 25 feet, small electric submersible pumps or compressed air (or nitrogen) displacement pumps designed for 2 or 4 inch diameter wells are used to purge monitoring wells. These pumps push water from inside the well to the surface through attached tubing and require downhole electrical or air lines to activate the pump. The flow rate of these downhole pumps rarely exceeds 2 gpm.

The inventor routinely purges 2" diameter monitoring wells where the water level depth is less than 25 feet with a 12 volt surface suction pump connected to dedicated (stays in the well) purge tube having a bottom check valve. The impetus for this invention was the effort required to purge some monitoring wells where the water level depths were greater than about 25 feet and where the flow rate of the surface suction pump was very low or zero. In these situations the inventor would purge the wells by hand by rapidly jacking the purge ~~tube up~~ and down until the requisite three to five well bore volumes were pumped from the well.

The invention provides a means of translating rotary motion in the horizontal plane, such as provided by a portable hand drill, to rapid, cyclic, up and down motion of a well pump tube so that the well can be pumped from any depth without placing a pump in the well. The present embodiment of the invention can pump a constant 2.5 gallons per minute from a 2 inch diameter monitoring well regardless of the water level depth or changes in the water level depth.

Other applications of the rotary-to-linear motion translater described herein are given in the claims section below.

BRIEF SUMMARY OF THE INVENTION

The invention uses rotary motion in one plane (e. g. horizontal plane) to cause sinusoidal linear motion in a direction normal to the plane (e.g. vertical plane - cyclic up and down motion). The up and down motion is transferred to a well pump tube with bottom check value so that water or other fluids can be pumped from any depth. Alternate embodiments of the invention replace the well pump tube and check valve with a driven piston, confining cylinder, and check valve to allow creation of a partial vacuum, compression of a fluid, or pumping of any flowable material.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be described in greater detail with reference to the accompanying perspective line drawing which illustrates a preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The components of the invention include at least one elliptical plate (1) mounted on a rotating shaft (2), which shaft (2) runs through the center of gravity of the plate (1) and whose axis is at an angle other than 90 degrees from the plane of the plate (2), and which shaft (1) is keyed or otherwise attached to the plate (2) such that rotational movement of the shaft (1) about its axis is transferred to the plate (2); mechanical support and bearing means (3) mechanically attached to the base plate (9) to provide rotational support to the shaft (2) and attached elliptical plate (1); at least one elliptical plate follower (4) affixed with rollers or bearing means (5) positioned on the top and bottom surfaces of the elliptical plate (1) at a fixed distance from the axis of the shaft (2); said follower (4) constrained by rollers (6) and roller races (7) or bearing means to allow

bidirectional linear movement of the follower (4) only in a direction parallel to the shaft (2) axis; support brackets (8) means for the roller races (7) mechanically affixed to the roller races (7) and base plate (9). As the shaft (2) rotates either clockwise or counterclockwise, the top and bottom surfaces of the elliptical plate (1) bear on the follower rollers (5) and cause the attached follower (4) to move in an alternating bidirectional lineal manner. The follower (4) travel distance parallel to the shaft (2) axis is determined by the distance of the follower rollers (5) from the axis of the rotating shaft (2) and the angle between the plane of the elliptical plate (1) and the axis the shaft (2). The bidirectional linear motion of the follower (4) is transferred to at least one well pump tube (10) with a bottom check valve (11) installed inside a well (12) by affixing the follower (4) to the pump tube (10) by at least one mechanical attachment means (13). With the shaft (2) axis aligned vertically, for every horizontal revolution of the shaft (2) and elliptical plate (1), the follower (4) and affixed pump tube (10) move one follower (4) travel distance down (down stroke) and one follower (4) travel distance up (up stroke). On the down stroke, the pump tube (10) is forced down one follower (4) travel distance with a velocity that opens the bottom check valve (11) which allows water to enter the pump tube (10) and displace water upward already in the pump tube (10). On the up stroke the pump tube (10) is forced up with a velocity that closes the bottom check valve (10) which allows water to be retained in the pump tube (10) and be lifted up one follower (4) travel distance. In this manner water is incrementally added to the pump tube (10) above the water level in the well. Once the pump tube is full of water, additional water added to the pump tube by alternating up and down strokes is discharged from the top of the pump tube (10) and from the well (12). At high rotational velocity of the shaft (2) and elliptical plate (1), the follower (4) and pump tube (10) move up and down with high velocity. On the up stroke, this high velocity imparts upward momentum to the water column in the pump tube(10). The imparted momentum is harvested to move water out of the pump tube (10) by the very rapid reversal of direction of the pump tube (10) on the high velocity down stroke.

For a constant angular rotation of the shaft (2) and elliptical plate (1) the velocity of the up and down motion of the follower (4) and affixed pump tube (10) is sinusoidal and the pumping rate of the invention is constant and independent of the depth to groundwater.